POLYCAPILLARY X-RAY OPTICS ENABLED DIFFRACTION-BASED PROCESS DIAGNOSTICS AND CONTROL

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Polycapillary x-ray optics has developed into an enabling technology for diffraction-based diagnostics and control. Production of high-intensity pseudo-parallel x-ray beams relaxes sample, smoothness, shape, and transparency constraints as well as source-sample-detector geometry constraints. In many cases, the usable x-ray intensity with low-power (typically, 50-80 Watt) sources is comparable to or even greater than that from high-power (2-10 KW) laboratory sources. Furthermore, development of compact, low-power, safe, stable, and reliable integrated source-optic combinations (X-Beams™) greatly facilitates the use of x-ray diffraction in scientific or industrial settings where use of x-ray diffraction has heretofore been impractical. Process applications for phase distribution measurements in the pharmaceutical and steel industries, thin film texture measurements for superconductor layers and magnetic films, and structure measurements for proteins will be reviewed. In addition, the potential for remote mineral composition measurements for geological and space applications as well as high spatial resolution strain distributions will be discussed. Future studies, including use of convergent x-ray and neutron beams will also be briefly reviewed. Although only preliminary results directly relevant to pharmaceutical processing are presented, it is hoped that a review of a broad range of *in situ* applications will elicit consideration of other potential applications in the pharmaceutical industry.